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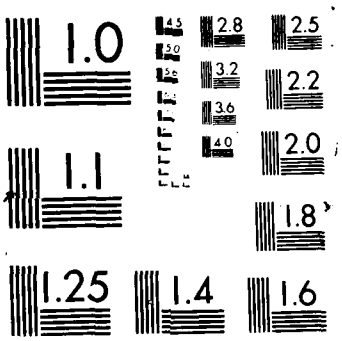
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Over the past year, significant progress has been made, including the completion of a prototype database management system, and the publication of several papers. The central contibution of this system, called Cactis, is that it is the first database system to introduce elegant and efficient means for managing derived data. The goal of Cactis is to provide this support within the context of a self-adaptive database implementation.

The project has also spawned a number of related efforts. The DBMS is being tested with a complex application, one that is of significant interest to the current research community - software environment technology. Other progress includes the development of a graphical interface to Cactis, one that maintains the philosophy of self-adaptiveness, by allowing the interface to adapt to the needs of a particular user. As an effort independent of Cactis, a system called Moby is under development.

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It is being coded in lisp, and is an experiement in extending database technology to include the one sort of derived data that Cactis cannot maintain - rule - based data. A final effort this year has been directed toward the support of complex constraints in the Cactis system. As many constraints may be represented as derived data, Cactis is a natural medium for this experimentation. This project is in cooperation with the Naval Ocean Systems Center in San Diego.

Annual Report on
ONR Contract N00014-86-K-0054

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September 21, 1987

Over the past year, significant progress has been made. A research prototype has been built and several papers have been published. The project has also spawned a number of related efforts.

The general goal of the project is to develop self-adaptive techniques for efficiently maintaining complex and computed data in a database. A first prototype of a database management system (called Cactis, for Colorado ACTive Semantics data model) has been implemented. It consists of over 80,000 lines of C code. The system uses a combined semantic and object-oriented data model, and thus supports complex constructed objects, and allows objects to encapsulate behavioral capabilities. In this way, data items may be much richer in structure than traditional databases allow, and they may have computed attributes. The system includes self-adaptive mechanisms for keeping computed attributes up to date, and for clustering data off-line.

The central contribution of Cactis is that it is the first database system to introduce elegant and efficient means for managing derived data. During this year, a paper on Cactis was submitted for journal publication [4], and a shorter, preliminary version was published in the proceedings of the Workshop on Object-Oriented Databases [2].

A significant amount of work went into researching the relevant data modeling literature before constructing Cactis. In this way, Cactis was able to encorporate state-of-the-art modeling techniques. As an offshoot of this project, a survey paper on semantic modeling has been accepted for publication in *ACM Computing Surveys* [5].

Besides completing the implementation of the system, progress has been made in several other directions. The DBMS is being tested with a complex application, one that not only is of significant interest to the current research community, but also requires a powerful data model and support for derived data. This application, software environment technology, is proving to be an interesting testbed for exploring the usability of Cactis, and for evolving its capabilities. A paper on these experiments was published in the annual ACM SIGMOD conference [3]. This work has caused us to reexamine the internal algorithms of Cactis, and a significant part of the system is being recoded, accordingly.

Other progress includes the development of a graphical interface to Cactis, one that maintains the philosophy of self-adaptiveness, by allowing the interface to adapt to the needs of a particular user. This project is meant to address a major, open research area: the construction of computer interfaces which are more flexible than traditional interfaces. The system is called Freeform and was described in a paper presented at the

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annual Very Large Databases (VLDB) Conference [6].

As an effort independent of Cactis, a system called Moby is under development. It is being coded in lisp, and is an experiment in extending database technology to include the one sort of derived data that Cactis cannot maintain - rule-based data. This system is one of the first true expert database systems, and is thus a contribution in an area of significant current interest to researchers and practitioners. Moby was described in a paper presented at the Very Large Databases (VLDB) Conference [1].

A final effort this year has been directed toward the support of complex constraints in the Cactis system. As many constraints may be represented as derived data, Cactis is a natural medium for this experimentation. This project is in cooperation with the Naval Ocean Systems Center in San Diego. Many of the results in the software environment paper [3] relate to this project.

Directions for next year include the integration of self-adaptive techniques for incrementally making schema changes at run-time (an important consideration for novel applications, like software environments), and the start of efforts to construct a distributed version of Cactis. This will prove of significant interest, as databases of the future will not only encompass richer data models, but will also run in workstation-based environments.

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